

responding figures twelve hours before leaving Arequipa being 91, 98.6°, and 20. On this trip there was much less exhaustion than on the previous one; in fact, all the symptoms of mountain sickness were less marked. It was possible to walk in the hut without great exertion; there was much less feeling of nausea, and considerable appetite. The night was passed comfortably, except for the cold, which was very disagreeable. Supper and breakfast consisted of hot beef tea and milk biscuits. In the morning, immediately after waking, the temperature of the body was 96.2°, pulse 112, and respiration 30. On the summit the writer felt fairly well when lying down, but the exertion of walking even a few steps brought on a feeling of exhaustion and nausea, and increased his headache. Otherwise, he felt well, and even had considerable appetite, although it would probably have been impossible to eat much, even had there been any food at hand. Twenty minutes after reaching the summit the temperature was 97.2°, pulse 120, and respiration 32. In an hour and a half the respiration was 35, the pulse and temperature remaining the same. In two hours the temperature was 96.8°, the pulse 112, and respiration 34. Three fairly good sphygmograph curves were obtained on the summit, not without considerable difficulty, however. These curves, so far as the writer knows, are with one exception the only ones ever secured at so great an altitude as 19,200 feet. In counting the pulse on the summit it was quite unnecessary to place the finger on the wrist, as the heart beats could plainly be heard. The descent was begun two hours and a half after reaching the top. At the hut, after again walking to and from the shelter, the pulse was 130, but the respiration had decreased to 30. One hour after arrival at the observatory at Arequipa the temperature was 98.2°, pulse 116, and respiration 22, and twelve hours after arrival the pulse had fallen to 82, about the writer's normal at the observatory, and respiration to 22, the normal being 20.

While the ascent of the Misti is a very easy one, and is not for a moment to be compared with the difficult climb up such mountains as Aconcagua or Mont Blanc, the altitude is so great that a study of the physiological effects it produces is interesting. The writer fared very well, better, in fact, than most of those who have made the ascent. One of the former assistants at the observatory made the trip more than fifty times and never experienced any discomfort, and one gentleman was so well on the summit that he was able to smoke there. These, however, are the exceptions. Almost everyone has headache, nausea, and a feeling of intense weakness, and many are subject to faintness. The experience of the native guides, who are of mixed Spanish and Indian blood, is very striking in contrast to that of foreigners. These natives are usually able to walk all the way to the summit from the hut without any difficulty, and feel as well on the top as they do at the base.

SEISMIC AND OCEANIC NOISES.¹

By SAMUEL W. KAIN and others.

(A) Mr. Samuel W. Kain, in his letter of April 27, 1898, says:

It gives me much pleasure to send you by this mail a copy of Professor Ganong's article. I am also sending you two short notes from lighthouse keepers at the mouth of the Bay of Fundy. Mr. McLaughlin is

¹The Editor is indebted to the kindness of Samuel W. Kain, Librarian of the Natural History Society, St. John, N. B., for these valuable contributions to the study of certain remarkable sounds that have been observed in many parts of the world at sea and near the coasts. References to these noises have frequently been made in *Nature* and other European journals, as also in the *MONTHLY WEATHER REVIEW* during 1896 and 1897. They are known as "mist puffers" off the coast of Holland and as "barisal guns" off the mouth of the Ganges. Mr. Kain's contributions establish the fact of their frequency in the Bay of Fundy.

at the southern end of Grand Manan; Mr. Suthern is on Brier Island, on the Nova Scotian shore.

I wrote to these men in order to get some more information about this phenomenon. I have also personally questioned masters of fishing schooners, all of whom are familiar with these sounds, and among whom they are known by the somewhat vulgar but very expressive name of "sea farts." I am sending you these papers because I think these sounds very similar to those discussed in Europe about two years ago by Van den Broeck, Darwin, and others. A reference to them in the *REVIEW* may elicit more information than we now have.

(B) Walter B. McLaughlin, of Grand Manan, on remarkable sounds like gun reports, etc. (read March 1, 1898, before the Natural History Society of New Brunswick, and now quoted from the *St. Croix Courier*):

I beg to say that my attention was first called to these sounds in August, 1838. I was then a boy nine years old. I was with my brother and a fine young sailor, by the name of McCraw, of Lower Grandville, N. S. We were hooking mackerel, and I had just caught my first mackerel when "boom" went this heavy sound and away went our fine school of fish. McCraw said, "There she goes." I inquired the cause of these sounds so frequently made and the sailor's answer was: "We don't know, we hear them, but we can't explain them."

I have no doubt that many sounds heard by people on the main land are actually reports of Indians' guns in porpoise hunting, or the reports of our signal guns on those outer stations, but a practised man will not be deceived. I have noticed these sounds for fifty-nine years. I long since satisfied myself that these sounds are subterranean. I have heard them under the sea, under Gannet Rock, under the land (in South Lubec), and under Grand Manan in two different places; and, strange to say, we have had two splendid shots under this station lately, one on the evening of January 28 and the second on February 14, 1897. When they take place under Gannet Rock and under the land they have the heavy rattle of a 24-pounder cannon, exploded 40 feet from the buildings; but when they happen under the sea they have a dull harmless "boom," as such a gun would sound if fired 50 or more fathoms under the sea.

We used to hear those dull sounds frequently between the Wood Islands and Gannet Rock. They would often sound like the rush of a heavy ground swell into a subterranean cave. We always noticed them on fine calm days. I think this was because there was no wind or other noise to drown them. The first one of those sounds I heard under Gannet Rock was about fifty years ago, one clear, dark night, about 2 o'clock, a. m., in my watch. I was reading and was deeply interested, when bang went the shock of what seemed to be like a 24-pounder cannon. It brought down the soot from a heavy, boiler iron, extension pipe on the chimney top into an open fireplace. I, of course, went outside to investigate and found a clear, dark night with few clouds and light winds. It was, I think, in October.

My next experience of one of those sharp shocks was in the month of June, 1856, at South Lubec, West Quoddy Bay. I was at a Dr. William Small's, and was having a game at cards with the doctor about 2 o'clock in the morning, when bang went one of those subterranean guns, which nearly upset our lamp. I exclaimed, "An earthquake!" but the doctor said, "No; it's an airquake," an explanation I never heard before nor since till I read it in the bulletin of the Natural History Society.

My third experience of those shocks on solid ground was at Seal Cove about eight years ago, say at 11 o'clock in the evening, when the shock was exactly as the former ones, the night being quiet and dark with very light winds. Again on the 28th of January of this year (1897) at 9 o'clock in the evening we got such a shock under this lighthouse that we thought the tops of our chimneys had gone by the board. Our dogs took to barking and our cattle tried to break loose in the stable. I noted this shock in my journal and told my people that we would hear of an earthquake on the mainland, but when the mail came we found that the earthquake was two days ahead of our tremor. On the evening of February 14, at 9 p. m., we received another shock, but not so violent as that of January.

I have given you my experience of fifty-nine years, and I will now affirm that I strongly believe these sounds are of subterranean origin.

(C) E. W. Suthern, from a letter to Mr. Kain, dated April 15, 1898, at Westport Light, Brier Island, Digby County, N. S.:

I have noticed these sounds many times when I have been out on the Bay of Fundy on fine, calm days in the summer. I spend a good deal of time in this way, shooting porpoises and birds. The sounds heard in this place are like the distant firing of heavy guns. I have heard these sounds on all sides of my boat, and that is what has puzzled me. I have heard them between my boat and the shore when one-half mile off shore, and again I have heard them in the same direction, ten miles off. I have also heard them in a southwesterly direction, and there is no land within 300 miles southwest of here, and I know that the Indians are not shooting porpoises in that direction.

In my opinion these sounds are not the firing of guns; they are heard

only in calm, warm weather, and never in the nighttime or in the winter. I have asked the fishermen about them and they say that they hear these sounds on all sides of them.

(D) W. F. Ganong, of Smith College, Northampton, Mass., on remarkable sounds, like gun reports, heard upon the southern coast of New Brunswick (dated December 24, 1896, Bulletin XIV of the Natural History Society of New Brunswick):

Everybody who has been much upon our Charlotte County coast must remember that upon the still summer days, when the heat hovers upon the ocean, what seem to be gun or even cannon reports are heard at intervals coming from seaward. The residents always say, in answer to one's question: "Indians shooting porpoise off Grand Manan." This explanation I never believed; the sound of a gun report could not come so far, and, besides, the noise is of too deep and booming a character. I have often puzzled over the matter, and it is consequently with great pleasure that I find in *Nature* for October 31, 1895, a short article by Prof. G. H. Darwin, in which he calls attention to the occurrence of what is obviously the same phenomenon in the delta of the Ganges, upon the coast of Belgium, and in parts of Scotland, and in which he asks for experiences from other parts of the world. Two explanations are suggested by his correspondent, M. Van den Broeck, of Belgium, who called his attention to the phenomenon, one that the reports are of atmospheric origin, due to peculiar electrical discharges; the other that they are internal in the earth, due, perhaps, to shock of the internal liquid mass against the solid crust. The following number of *Nature* contains notes which suggest that the reports may accompany the formation of faults or may result from earthquakes too slight to be otherwise perceived, and later numbers of that journal contain numerous letters upon strange sounds heard in different parts of the world, with various explanations.

The discussion upon the subject by this society on December 3, 1895, has called out further information showing that others besides myself have noticed these or similar sounds in New Brunswick. The late Edward Jack, a keen observer of things in nature, wrote me under date December 13, 1895, "I have often noticed in Passamaquoddy Bay, when I was duck shooting in the early spring mornings, the noises of which you speak; they always seemed to come from the south side of the bay. They resembled more the resonance from the falling of some heavy body into the water than that of the firing of a gun, such as is produced by a cake of ice breaking away from a large sheet of it and toppling over into the sea. These noises were heard by me only in very calm spring mornings when there was no breath of air; * * * there was nothing subterranean in them." Capt. Charles Bishop, of the schooner *Susie Prescott*, has told Mr. S. W. Kain that he has heard these sounds 40 miles from land between Grand Manan, the Georges Banks, and Mount Desert Rock. They are reported also from the Kennebecasis. Mr. Keith A. Barber, of Torryburn Cove, wrote December 26, 1895, to this society: "I have heard sounds similar to those on the Kennebecasis in the warm days of summer. They seemed to come from a southeasterly direction." Mr. Arthur Lordly, a member of this society who resides in the summer at Riverside, has also told Mr. Kain that he has heard similar sounds, on clear warm days, on the Kennebecasis, from a southwest direction. No other reports of this occurrence in New Brunswick have reached me. The *Scientific American* (June 27, 1896, p. 403) has called attention to them and requested that observations be communicated to its columns, but apparently so far without result.

The latest opinion as to the origin of sounds appears to favor an atmospheric origin, possibly connected with electrical disturbances. A very detailed circular, calling for exact observations, with series of questions and blank forms has been issued by M. Van den Broeck, of Brussels, who appears to have been the first to call scientific attention to them. It is very desirable, since the sounds occur here, that they should be scientifically observed and recorded; and it will be best to communicate the results to this society, through which they will reach those who can make the best use of them. To secure the best results the following form, altered somewhat from M. Van den Broeck's circular, should be followed:

Name of observer.
Date of observation.
Exact place of observation.
Exact time of each observation.
Direction of the sound.
Character of the sound (full description with comparisons).
Wind direction and velocity.
State of the sky.
State of the sea.
Mist conditions.
Barometer (state of the weather a few hours before and after).
Temperature.
Other remarks, including suggestions as to their origin, and reasons why they can not be gun reports.

(E) Although the above-described sounds have generally been attributed to some form of disturbance within the earth,

the noise from which comes up through the ocean, and although they are, therefore, called *seismic* noises, yet it is by no means certain that they may not have a very different origin and it would be more proper to call them *oceanic* noises. The descriptions given of these oceanic noises show that sometimes they have precisely the same characteristics as the noises that may be heard in an aquarium when one stands alongside of a big glass tank and watches the motions of the drum fish. The salt water drum fish (*Pogonias chromis*) is common on the Atlantic Coast of the United States, and other varieties will doubtless be found in other parts of the world. A large drum fish will give out a sound that may be heard a long distance. As the sound is refracted into a nearly horizontal direction on its emergence from a level surface of water, it may seem to come from a great distance in the air when it really is near at hand in the water underneath or near to a fisherman's boat. If there are other fishes of great size that can give forth louder sounds, having different notes, we should not be surprised at the variety of descriptions of the various mysterious sounds. But at present these oceanic noises defy all attempts at rational explanation; we must wait until accurate observations have been collected.

As these sounds appear to be very frequent on fine, calm summer days in the Bay of Fundy, it seems practicable to start a special investigation of the subject in that neighborhood. The actual direction whence a sound comes that originates under water can best be studied by means of a pair of tubes whose lower ends are closed by metal or preferably glass plates. The upper end of the tube being open and in open air while the lower end is immersed several feet under water and pointed successively in different directions, we have only to ascertain the direction for which the sound that enters the tube is strongest in order to know the direction whence it comes. The use of this tube avoids the error incident to the refraction of the sounds as they emerge from the surface of the water.—Ed.

(F) Through the kindness of Prof. Alexander Agassiz, the Editor has been favored with the following note, under date of May 23, 1898, from Dr. S. Garman, Ichthyologist to the Museum of Comparative Zoology at Cambridge, Mass.:

The list of noisy fishes is an extensive one; it runs through the *Scienoids*, *Cottoids*, *Batrachoids*, *Cyprinoids*, *Siluroids*, *Gymnodonts*, and others. Most of them are small and their voices are not loud. *Myliobatis*, *Etobatis*, and *Rhinoptera*, among the rays, are said to make a noise by grinding their teeth when caught; it may be they also do it when feeding. But the fishes that will best answer the queries of your correspondent are the large *Scenidae*, many of them probably more or less noisy. In their cases the dates of hearing the sounds should be noted. The large "drum," *Pogonias*, attains a length of more than 4 feet. The following, from page 118 of Holbrook's *Ichthyology of South Carolina*, 1860, relates to it: "At this time [April] the drum enters the different bays and inlets of salt water along the shores of South Carolina to deposit its spawn, and then begins its drumming noise; this season passed, the sound is no longer heard, and the fish is then rarely taken."

"The way in which the singular sound called drumming is produced has not hitherto been satisfactorily explained. Cuvier observes that it may depend upon the air bladder, though he says it has no communication with the external atmosphere. DeKay supposes it 'to be occasioned by the strong compression of the expanded pharyngeal teeth upon each other.'

"Frequent examinations of the structure and arrangement of the air bladder, as well as observations on the living animal just taken from the water, when the sound is at intervals still continued, satisfied me that it is made in the air bladder itself; that the vibrations are produced by the air being forced by strong muscular contractions through a narrow opening, from one large cavity, that of the air bladder, to another, that of the cavity of the lateral horn; and if the hands be placed on the side of the animal, vibrations will be felt in the lateral horn corresponding with each sound."

"Ichthyologists differ also as to the character of the sound. Schœpff speaks of it as 'a hollow, rumbling sound under water;' Dr. Mitchell, as a 'drumming noise;' Dr. DeKay says when the fish is 'freshly taken from the water it sounds as if two stones were rubbed together.' It resembles most the tap of a drum, and is so loud that when multi-

tudes of them are collected together it can be heard in still weather 'several hundred yards from the water.'"

The drum of which Holbrook writes is *Pogonias cromis* Linne, 1766.

(G) Note by Prof. A. E. Verrill, of Yale University, New Haven, Conn. (dated May 31, 1898):

There are numerous fishes, both marine and fresh water, that are capable of making sounds of considerable volume under water. Such fish noises might very well account for many instances of the noises referred to. The drum fishes, the "grunts," are good "examples of sound-producing fishes."

(H) To the preceding note by Dr. Garman the editor would add the suggestion that the intensity and character of the sound, as heard in the air, will depend somewhat upon the relation between the depth of the fish in the water and the pitch of the note uttered by it.

Just as the vibrating column of air in an organ reed pipe produces the greatest effect when it is in perfect unison with the vibrating tongue at the base, so it is with the column of water above the drum fish. An open organ pipe that is controlled by a spring or reed that vibrates to the lowest C of the bass clef, namely, thirty-two times per second, must have a length of 16 feet. The same pipe, if filled with fresh water, may be longer in the ratio 4708/1093, viz, the ratio between the velocity of sound in air and water. This gives a depth of about 70 feet at which the drum fish that strikes the bass C could produce the maximum noise as heard by the observer. If, now, the bottom of the water is 70 feet below the fish then he is at a nodal point, and the whole column vibrates in sympathy with him.—Ed.

(I) Prof. William F. Ganong writes from Northampton, Mass., as follows, May 31, 1898:

I can not in the least accept your suggestion about the drum fish. It is true I have never heard this animal perform, but the sounds come from too far off and are too great to be made by a fish. On hills a quarter of a mile from the sea I have heard them, and the sound filled the air. Your mode of investigating them by the tubes would be difficult in practice, since the sounds come so rarely; days will pass without our hearing them, and even on favorable days they occur only once in a while, perhaps once in a day, but at the best they occur several hours apart as a rule; in fact, they may be described as rare and irregular. Hence, one would have to be on constant guard at the tube for hours and even days together. Mr. McLaughlin, of Document B, is a man for whose powers of observation and reliability I have the greatest respect, and his letter is, therefore, an important contribution to this subject.

(J) Instead of accepting any hypothetical explanation as satisfactory, it is best, at the present stage of the investigation, to keep one's mind free from prejudice in any special direction. It seems quite possible that the noises proceeding from the ocean may have very different characters and origins; some are undoubtedly due to the drum fish; others are made by the breakers dashing on rocky cliffs, whence heavy thuds spread for several miles through the air and many miles farther through the ocean; others are due to the cracking of rocks in ledges near the surface, such as those on which lighthouses are built; others, finally, are occasionally due to genuine earthquakes occurring at the bottom of the neighboring ocean. It is highly probable that a careful collation of observations from many stations in any given locality, such as the Bay of Fundy, will throw a clear light upon the locality whence the noises emanate.

In this connection it is worth calling to mind that there are eight or ten well-defined regions on the North American Continent within each of which there is a so-called center of seismic disturbance. There is no reason why similar centers should not exist under the ocean; in fact, the great solitary waves that have been frequently reported by vessels between New York and Newfoundland, and which have generally been plausibly explained as due to a combination of several ordinary waves, may sometimes be due to suboceanic earthquakes, just as similar great waves are known to have been produced by earthquakes in the Pacific.—Ed.

METEOROLOGICAL WORK IN ALASKA.¹

By A. J. HENRY, Chief of Division.

The meteorological work in Alaska and contiguous territory prior to the establishment of a weather service by the United States was admirably summarized in 1879 by Dr. William H. Dall, in his contributions to the Pacific Coast Pilot, published by the United States Coast and Geodetic Survey. The following remarks relate more especially to the work of recent years.

In the summer of 1872 the Federal Government sent a special agent to the Pribilof Islands for the purpose of studying the life and habits of the fur seal, concerning which little was then known.

As a promising field of collateral investigation the Signal Service, under the direction of Gen. A. J. Myer, began a series of meteorological observations on the island of St. Paul in August of the same year. The instructions given to the first observer detailed for duty in Alaska, Mr. Charles Pattison Fish, were very comprehensive. In addition to his daily routine duties, which included the making of six meteorological and certain special tidal observations, he was to keep accurate memoranda on a variety of subjects, some of which had only a remote connection with meteorology.

Mr. Fish remained on the island until the summer of 1876, when he was relieved by Mr. Edward J. Gill. The latter perished on October 22 of the same year in an attempt to reach his quarters during a violent storm. Shortly after the death of Mr. Gill observations were resumed by an employee of the Alaska Commercial Company and continued with some interruptions until June 30, 1883, when they were finally discontinued by the Signal Service. It is understood, however, that meteorological observations have since been made by the company above named, in fact, a more or less complete register, extending from September, 1892, to June, 1895, made by that company, was sent to the Weather Bureau in 1895.

After the occupation of St. Paul, in 1872, meteorological stations of the first order were next established at Fort St. Michael in 1874, Unalaska in 1878, Atka in 1879, and Sitka in 1881.

Interest in meteorological work in the arctic regions was greatly stimulated in all quarters by the discussions of the International Geographical and Meteorological Congresses of 1879-81, and especially by the action of the congress in formulating plans for the establishment of an international chain of magnetic and meteorological stations at high latitudes. The part taken by the Signal Service in the general scheme of international work is a matter of history, the details of which have been fully published elsewhere. As supplementary to the main work at high latitudes active operations were begun with a view of increasing the number of observing stations in Alaska. The formal order on the subject, approved March 16, 1881, follows:

INSTRUCTIONS No. 31.

There will be establishment in Alaska, under the supervision of the Signal Service observers on duty there, substations and third-class stations, as follows:

¹ The importance of extending our daily weather map to the greatest possible extent, so as to include all the circumstances attending our storms and cold waves, was deeply impressed upon our attention during the progress of the work of the Signal Service in 1871, and the Chief Signal Officer, Gen. A. J. Myer, willingly accepted the idea of taking the most generous possible interpretation of our privileges and duties in this respect. The limit covered by our system of observing stations was first extended in June, 1871, by distributing forms to masters of vessels along the Atlantic Coast; in 1872 the first steps were taken toward securing data from Alaska; and in 1873 General Myer began the organization of the international system of simultaneous meteorological observations which soon covered the whole Northern Hemisphere. It is to be hoped that the publication of the International Bulletin has done much to stimulate the study of the atmosphere as a whole. Climatology may deal with very restricted localities, but meteorology must consider the whole atmosphere.—Ed.